

# Notice of Allowability

Application No.

10/525,045

Examiner

Monica D. Harrison

Applicant(s)

SAKAI, SHIGEKI

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to applicant's amendment filed 2/6/07.
2. ☒ The allowed claim(s) is/are 1 and 3-23.
3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) ☒ All b) ☐ Some\* c) ☐ None of the:
    1. ☒ Certified copies of the priority documents have been received.
    2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
  5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
    - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_\_.
    - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

## Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO/SB/08),  
Paper No./Mail Date 12/21/06
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material

5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413),  
Paper No./Mail Date \_\_\_\_\_
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_\_

  
CARL WHITEHEAD, JR.  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 2800

**DETAILED ACTION**

1. Applicant's amendments filed 2/6/07 have been entered. Examiner acknowledges claim 2 is cancelled.

***Allowable Subject Matter***

2. Claims 1 and 3-23 are allowed over the prior art of record.

***Reasons For Allowance***

3. The following is an examiner's statement of reasons for allowance: The prior art does not disclose nor fairly suggest a semiconductor ferroelectric storage device as described in independent claims 1 and 6 nor the process for producing a semiconductor ferroelectric storage device as described in independent claims 9 and 19.

When the insulator buffer layer is an oxide containing hafnium and aluminum as constituent elements, a target composition of  $\text{Hf}_{1-x}\text{Al}_{2x}\text{O}_{2+x+y}$  is used. Alternatively,  $\text{HfO}_{2+u}$  and  $\text{Al}_2\text{O}_3$  may be used. In this case, although the two targets may be simultaneously vaporized (sputtered), use may be made of a method in which the two targets are each alternately vaporized one or more times to synthesize  $\text{Hf}_{1-x}\text{Al}_{2x}\text{O}_{2+x+y}$  through a heat treatment. When  $\text{HfO}_{2+u}$  and  $\text{Al}_2\text{O}_3$  are alternately deposited, it is especially preferred to deposit  $\text{HfO}_{2+u}$  first. When the insulator buffer layer is an oxide containing hafnium as a constituent element, a target composition of  $\text{HfO}_{2+u}$  is used. Since the insulator buffer layer is an oxide, oxygen gas is introduced during formation. It is especially preferred to mix oxygen gas with nitrogen gas for the purpose of inhibiting and diminishing the formation of an oxide layer having a low-permittivity at the interface between the silicon and the insulator buffer layer. Nitrogen can also diminish structural defects in the insulator buffer layer and reduce leakage current. When an oxygen/nitrogen mixed

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gas is used, the N:O mixing molar ratio is from 1:1 to  $1:10^{-7}$ . Since the  $\text{Hf}_{1-x}\text{Al}_{2x}\text{O}_{2+x+y}$  and  $\text{HfO}_{2+u}$  targets themselves contain oxygen and because hafnium atoms and aluminum atoms readily form oxides, nitrogen gas only may be introduced during the formation of an insulator buffer layer.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Monica D. Harrison whose telephone number is 571-272-1959. The examiner can normally be reached on M-F 7:00am-3:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Monica D. Harrison  
AU 2813

mdh  
March 1, 2007